RESISTANCE INCREASE TO METHYL PARATHION BY THE BOLLWORM, *HELIOTHIS ZEA* (BODDIE), IN OKLAHOMA SINCE 1966, AND LD_{50} DETERMINATION FOR THE BUDWORM, *HELIOTHIS VIRESCENS* (F.)

By

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PREFACE

Bollworm resistance to methyl parathion has recently been found in Northern Mexico and Southern and Central Texas by Adkisson and Nemec (in Deterling 1971). To determine bollworm resistance increase levels in Oklahoma since 1966, and an LD_{50} value for the budworm, larvae were field collected and allowed to mature. Emerging adults were paired and their offspring were treated with known concentrations of methyl parathion.

Data were analyzed using the method developed by Finney in 1952 (in Dixon 1968) and current dosage-mortality curves were established.

Appreciation is expressed to Dr. Jerry H. Young, my major adviser, for his support in preparation of this manuscript. Gratitude is expressed to my committee members, Drs. W. A. Drew and R. D. Eikenbary, and to Dr. D. C. Peters for their constructive criticism of this manuscript. Sincere thanks is extended to Dr. R. D. Morrison of the Statistics Department for aid in analyzing the data; to Dr. J. G. Burleigh, Entomology Research Associate and Duane Boy, undergraduate in Entomology for their advice and help in maintaining the test colonies.

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INTRODUCTION

RESISTANCE INCREASE TO METHYL PARATHION BY THE BOLLWORM, *HELIOTHIS ZEA* (BODDIE), IN OKLAHOMA SINCE 1966, and LD_{50} DETERMINATION FOR THE BUDWORM *HELIOTHIS VIRESCENS* (F.)

The most damaging insect pests to cotton in many areas are the bollworm, *Heliothis zea* (Boddie) and the tobacco budworm, *Heliothis virescens* (F.), more commonly called the bollworm complex. Crop losses and control costs due to this pest run several million dollars a year (Murray 1972).

The development of resistance in a complex such as this is important in that it adds to the losses already inflicted. Initially, it requires increased amounts of insecticide for control, and secondly, it necessitates the development of new control measures.

Resistance to DDT was first noted in Texas in 1962 (Brazzel 1962). Resistance to methyl parathion was not observed at that time. Later studies (Lowery 1966; Adkisson and Nemec 1967; and Graves et al. 1967) again showed little or no resistance to methyl parathion.

Carter et al. (1968) demonstrated that methyl parathion resistance was hereditary in laboratory strains of the bollworm and projected that field resistance would soon occur.

Resistance was soon found in Northern Mexico and Southern and Central Texas by Adkisson and Nemec (in Deterling 1971) ranging from 169 fold in Northern Mexico to 26 fold in Central Texas since 1964.

This study was undertaken to determine bollworm resistance increase to methyl parathion in Oklahoma since 1966, and to determine the LD_{50} level for the budworm, *Heliothis virescens* (F.).

MATERIALS AND METHODS

Bollworm and budworm larvae were field collected from cotton at Chickasha and Tipton, Oklahoma, during September 1971, and they were allowed to mature. Emerging adults were paired and their offspring were collected individually in 1-oz plastic jelly cups containing approximately 1/2 oz of bean diet (Burton 1969). Rearing took place in a controlled temperature room at the entomology insectory with a 12-hour photoperiod at 80±5°F. Only third instar larvae weighing between .02 and .04 grams were tested.

Technical grade methyl parathion dissolved in 1000 ml of acetone in amounts of 1.25, 2.5, 5, 10 and 20 g was used for testing.

As the larvae became available they were randomly assigned to receive one of the 5 treatments. Each treatment was repeated 5 times using 40 larvae per replicate. The larvae were treated by applying 1 µl of a known concentration of methyl parathion in acetone solution to the dorsum of the thoracic region by means of an electric micro-dispenser.® (Demick Enterprises, El Cerrito, Calif.) driving a calibrated syringe.

Mortality counts were made 48 and 72 hours after treatment when larvae were recorded as dead or alive. Sluggish larvae were recorded as alive. The 72 hour observations were used for analysis. Acetone treated checks were used to determine any effect of the solvent on larval mortality. Raw data are given in Table I.

Data were analyzed on an IBM 360 computer using the program designed by Finney in 1952 (in Dixon 1968). The intercept, a, and the slope, b, are estimated for the response curve $Y = a + bx$ where Y is the probit response and x is the log dose in micrograms (μg) of insecticide per gram of body weight.

Five points were used to establish each curve. Two hundred larvae were tested per point. Numbers were consistent both within and between each curve. No significant mortality was noted in the acetone checks.

The median lethal doses were plotted on log normal paper and a straight line eye fitted through these points.

RESULTS AND DISCUSSION

Results of the tests are shown in Figures 1 and 2, respectively. Figure 1 represents the probit LD_{50} lines for 1966 (Young et al. 1966) and 1971 for the bollworm. No significant difference was found between larvae collected at Chickasha and Tipton, and data for both locations were plotted as one line.

Data for the budworm are presented in Figure 2. Again, no significant difference was noted between larvae from either location. In this case, no earlier data was available for comparison.

In 1966, 1 μg of methyl parathion was required to produce 50% mortality in the bollworm. In 1971, it required 15.6 μg, representing a 14.6 fold resistance increase.

The value determined for the budworm was 24.7 μg per gram. This is logical as the bollworm has been shown to be more susceptible to insecticides than the budworm (Brazzel et al. 1953, Gast et al. 1956).

The figures obtained for 1971 indicate that a definite resistance increase, though not as high as that found in Northern Mexico and Texas (Deterling 1971), has occurred in Oklahoma.

Probably the main reason why this has not become a major problem yet is the fact that the bollworm does not attack cotton in Oklahoma until late in the season when the crop is fairly well made. Even so, this not only causes an increase in the amount of material required to control the bollworm, but it also adds to the production cost of the crop.

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APPENDIX

TABLE I. *Heliothis zea* and *Heliothis virescens* larvae response to methyl parathion.

	Concentration of methyl parathion in grams per 1000 ml of acetone				
	1.25	2.5	5	10	20
	Heliothis zea				
Number treated	200	200	200	200	200
Number responding	103	138	144	174	192
Number not responding	97	62	56	26	8
	Heliothis virescens				
Number treated	200	200	200	200	200
Number responding	69	80	93	117	149
Number not responding	131	120	107	83	51

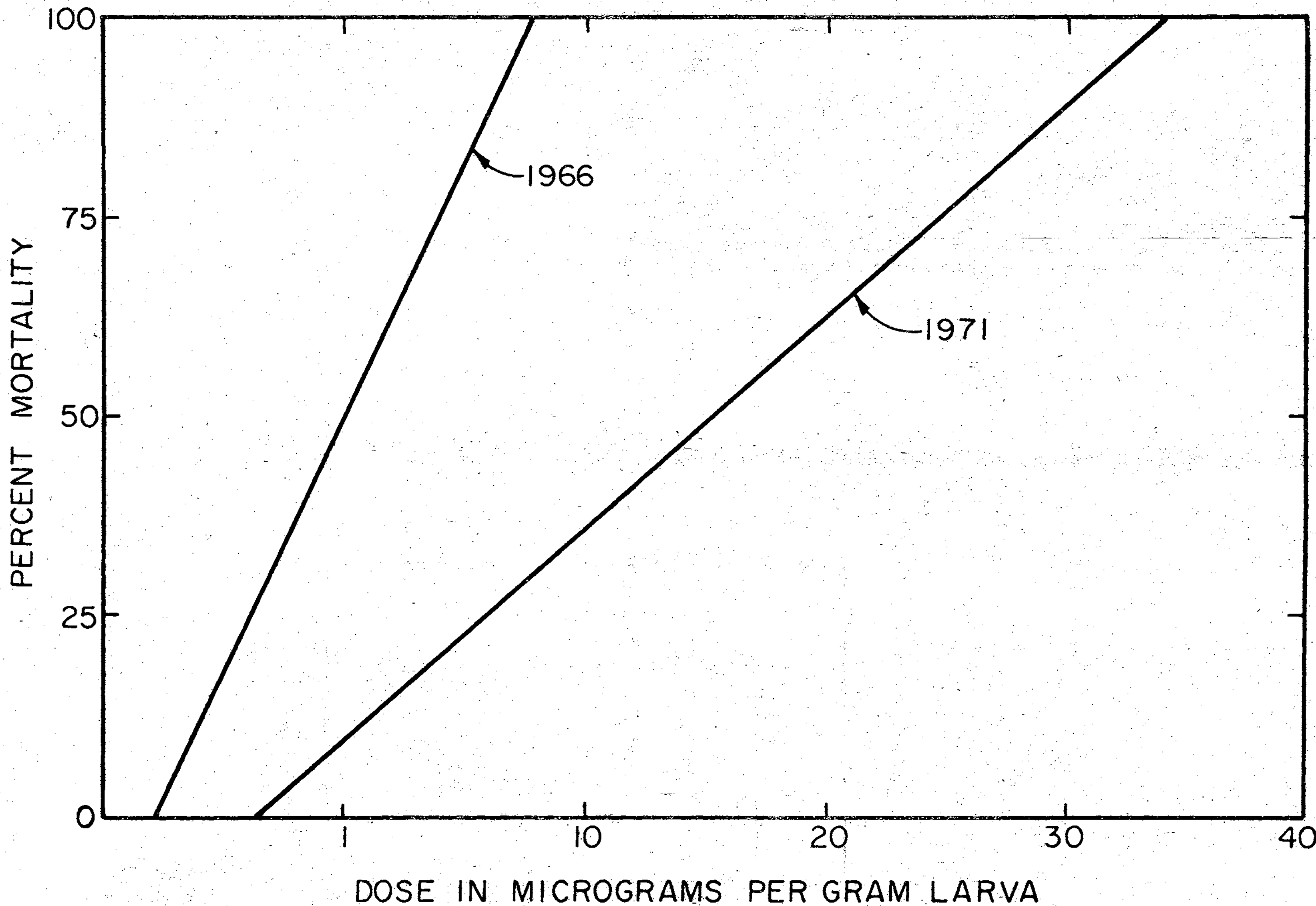

Figure 1. LD_{50} value comparison for the bollworm, 1966 and 1971.

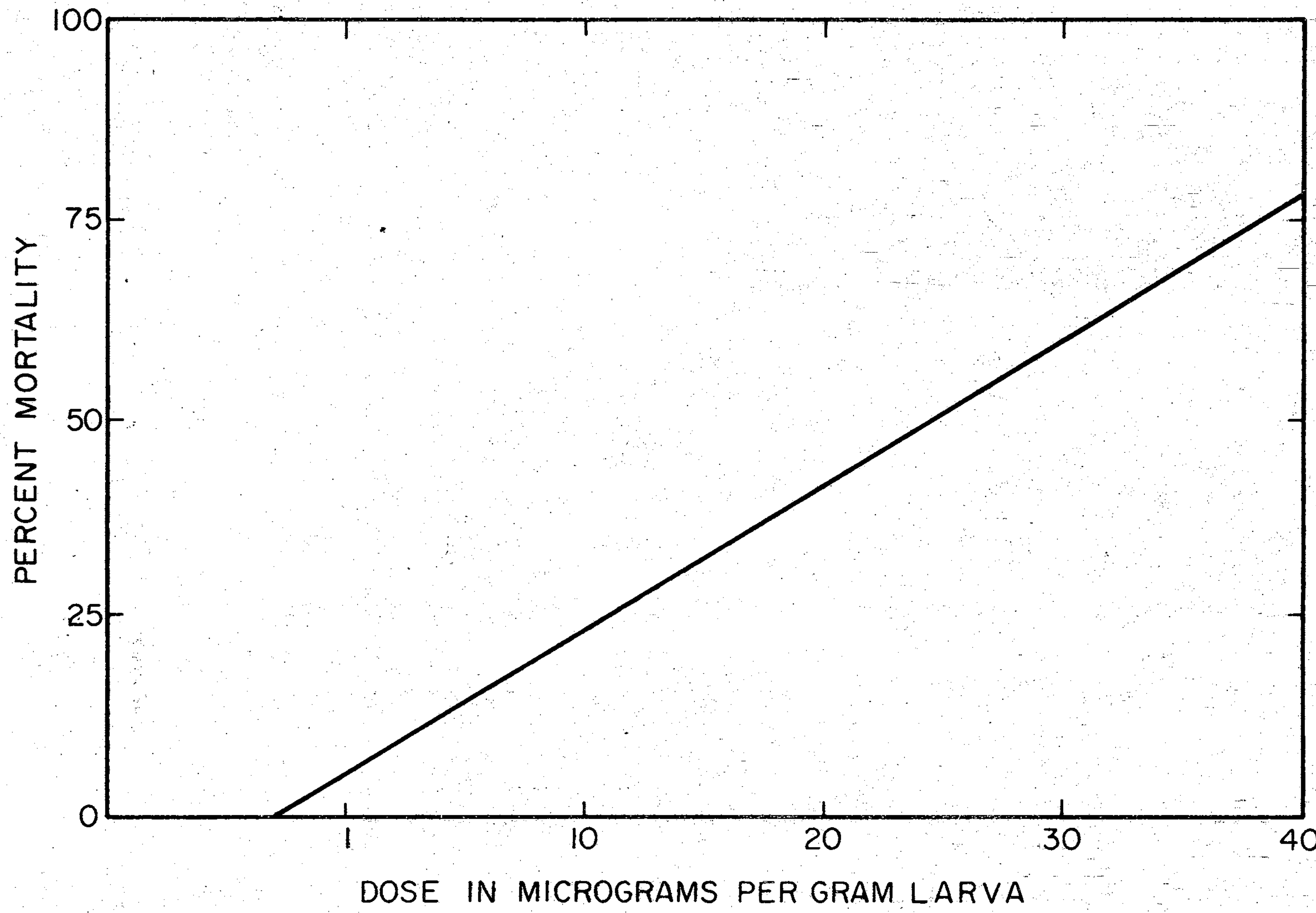

Figure 2. LD_{50} value for the budworm.

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